MAINTENANCE OF MACADAM ROADS WITH BITUMINOUS MATERIALS

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The cost of maintenance of macadam roads by repeated applications of stone and by dragging has mounted to such enormous heights, due to the increased volume of traffic, that we must resort to some other form of maintenance whereby these costs can be reduced. Maintenance with bituminous materials is then a subject of extreme importance at this time, because by means of surface treating with bituminous materials we are able to salvage the old macadam foundation, product a surface which is maintained more easily and at less cost and provide a dustless surface for the traveling public and residents along the road. Surface treatment has been practiced for a number of years with very satisfactory results and since the idea is not new it will be my endeavor in this discussion to give you some of the methods of application, proportions of bituminous materials and covering as is practiced by the State Highway Commission.

Inasmuch as surface treatment can not provide drainage, a foundation or a base, only such macadam roads as already have these fundamentals should be considered for treatment. A great deal of money has been wasted on surface treatment because a careful study of the road construction was never made. Improper proportioning of materials, no consideration given to the amount of traffic the road must carry, and no provision for future maintenance are all important causes of failure in surface treatment.

Preliminary Work

Preparatory to surface treatment, we must first correct the surface of the old macadam road. An extreme crown should be eliminated by laying either a water-bound or traffic-bound macadam patch along the edges of the old macadam. This should be done either early in the season or a season in advance of the treatment. Next, such holes or ruts as may be found in the old road should be carefully patched, either with a water-bound macadam patch or with a bituminous concrete patch.

The introduction of bituminous cold patching materials has made the bituminous concrete patch both easy and economical to lay. Such a patch can be laid in a hole or depression from ¾ inch to 3½ inches in depth. Deeper holes should first be filled with No. 2 stone to within two inches of the surface and

thoroughly tamped. The bituminous patch can then be laid on this foundation. The bituminous materials used in making this patch can be either tar cut back, asphalt cut back, or asphalt emulsion. The size of the stone used depends upon the depth of the hole and may range from ¾ inch to 2½ inches. Where the coarser stone are used a small portion of stone chips and clean coarse sand must be added to give a consistent mix. The amount to be added will have to be determined by experiment. Likewise, the exact proportion of bituminous materials used will depend on the quality and sizing of the stone and must be determined by experiment. Just enough bituminous material should be used to thoroughly coat the stone when it is properly mixed, so that no white spots will appear on the stone. Since the bituminous cold patch is used more often in the maintenance of bituminous macadam, I will discuss the manner of laying the patch later.

After the surface of the old road has been prepared for treatment, the next step of importance is the choice of bituminous material to use. The bituminous materials most commonly used for surface treatment are tars—hot, medium and cold; asphalt oils—hot, medium and cold, asphalt cut back and Trinidad cold oil. Which grade of these tars or asphalts to use, whether heavy, medium or light, will depend on the condition of the road to be treated, the amount of traffic and the future plans for maintenance.

Also the quantity of bituminous material to use, the amount of cleaning of the surface required and the amount and grade of stone required for covering will depend upon the nature of the surface to be treated, the amount of traffic and the kind of bituminous material used.

Before the application of the surface treatment one of the foremost and important essentials is the proper cleaning of the road surface. Where the heavier asphalts and tars are used, the surface should first be cleaned by the use of shovels, fiber brooms, and mechanical sweepers until the large stones comprising the macadam surface are completely exposed and clean, but not dislodged. The sweeping should be continued until the voids are exposed to a depth of about ½ inch, and the dust completely removed. When the medium asphalts and tars are used the sweeping need be carried only so far as to expose the voids in the surface. With the use of the light oils only the mud, dirt and excess loose dust or other foreign matter need to be removed from the surface, and but little if any sweeping will be required. Where the surface has been swept clean by auto traffic of all dust and screenings, so that the large stones in the surface are exposed, the cold oil treatment should not be used.

Application of Bituminous Material

The application of the bituminous material should be made by a pressure distributor mounted on a truck. The material should be sprayed on with considerable pressure as this will remove any thin layer of dust on the stone and aid in the bonding of the bituminous material to the surface.

The amount of bituminous material applied will depend on the nature of the surface, the amount of traffic and grade of material used. For the first treatment on a water-bound or traffic-bound macadam surface the heavier asphalts may be applied from 1/3 to ½ gal. per sq. yd., the medium asphalts from 1/3 to ½ gal. per sq. yd., and the lighter oils from 1/3 to ½ gal. per sq. yd. The heavier tars may be applied from 0.4 to 0.5 gal. per sq. yd., and the cold tar from 1/3 to 0.6 gal. per sq. yd.

Where more than ¼ gal. per sq. yd. of bituminous material is used, it should be applied in two treatments. The second treatment can be applied as soon as the first treatment has been covered with just enough screenings to prevent the bituminous material from picking up or sticking to the wheels of vehicles and prevent the second treatment from flowing off while applying it.

For re-treatments, that is successive treatments applied each year, a much less quantity will be required. Usually 1/3 gal. per sq. yd. will give satisfactory results.

Covering Material

The amount and kind of covering material necessary will depend on the kind of bituminous material used and the condition of the road surface before the application. Ordinarily for the lighter oils no covering at all will be required for the first application, and this is also true when no more than 1/3 gal. per sq. yd. of cold tar is used. However, on succeeding applications of cold tar, a thin application of clean coarse sand or grit should be used. For the first treatment with the heavier asphalts and tars the amount of covering may range from 60 to 80 pounds of crushed stone per gallon of bituminous material used. The stone should be of a size passing a 1¼ inch circular opening and retained on a ½ inch screen. This size stone should constitute about 75 per cent of the covering and to this should be added about 25 per cent of chips or stone passing a ¾ inch circular opening and retained on a ¼ inch screen. This will give a better seal and make a uniform surface, for succeeding treatments of the heavier asphalts and tars, 30 to 60 pounds of stone chips per gallon of material used.

The use of the proper amount of covering is one of the very essential things to insure the success of bituminous surface

treatments. However, owing to the variable conditions affecting the screenings required the best rule that can be made is to use just enough covering and no more than is required to prevent the bituminous material from being picked from the road by traffic. The surface should always look black after it has been ironed out by traffic. If it does not look black, but looks dry and light in color, it is an indication that too much covering has been used. There is not so much danger, however, in overloading with heavier asphalts as when lighter grades are used.

Screenings may be applied from piles of stone at the roadside by men with shovels or spread directly from dump trucks by opening the tail-gate just sufficiently to allow the stone to sprinkle uniformly on the surface. On sharp grades, the truck can not be used on account of slipping. The covering in all cases should be done in such a way as to insure an even distribution over the surface. Where the bituminous material is applied in two courses, only enough screenings should be applied after the first course to prevent picking by traffic, and keep the second course from flowing off when being applied. During the past year, the State has made use of the four-way steel drag and a No. 5 road maintainer for following up and smoothing the surface after the screenings have been applied. The drag serves the two-fold purpose of thoroughly coating the screenings with the bituminous material and dragging the excess screenings into the depressions, thus smoothing out the surface. Following up with the maintainer will eliminate any mark of ridges which might be left by the drag, thus giving a smooth uniform distribution over the entire surface.

A bituminous surface treatment should be repeated when it becomes necessary to replace the treatment previously applied. Usually succeeding treatments should be applied each year for two or three years after the first treatment has been made after which time re-treatment can be made two or more years apart.

Patching

Should holes or ruts occur before a re-treatment is applied, they may be eliminated by being brought up to the proper elevation by cold patching, which I have mentioned before, or by a bituminous paint patch where the depression is less than one inch in depth. In making the cold patch, the hole in the surface should not be enlarged or deepened, but must be thoroughly cleaned of all loose dust or foreign matter and swept clean. When asphalt and tar cut backs are used, the surface must be perfectly dry, but where asphalt emulsion is used, the hole may

be flushed with water, but no excess water should be left standing in the hole. When clean, the surface to be patched must be painted with a bituminous material which may be the same as that used in making the patch. It is especially important that the edges of the hole be carefully painted but care must be taken not to use too much of the bituminous material in so doing.

The depression will then be filled with the bituminous mixture and thoroughly compacted in place by tamping or rolling. On this should be spread a light covering of coarse sand or grit and the tamping continued. The bituminous mixture may be prepared by either mixing on a platform or by use of a small concrete mixer. Where there is a quantity of patching to be done it is more economical to mix the material at a central mixing station and haul the mixture by truck to the roads that are to be repaired.

With the use of the asphalt and tar cut backs, the mixture should be placed in a pile and allowed to season sufficiently so that it will bind when the patch is made. This will require from 24 to 48 hours. Asphalt emulsion may be used as soon as mixed. It should not be allowed to stand for any great length of time, because it will become too hard to handle easily.

In making a paint patch when the depression is less than one inch in depth, the surface is first swept clean with a steel fiber broom followed by a house broom. When the surface is clean and dry, the depression may be painted with either medium or cold tar, hot asphalt or asphalt emulsion. The hot asphalt and medium tar will have to be heated before using. The cold tar can be used on an ordinary summer day without heating. Asphalt emulsion can be used at any ordinary air temperature. Stone chips will then be spread on the painted surface and thoroughly tamped until the bituminous material is forced into the chips a sufficient depth to bond them to the surface. The chips should then be covered with a thin coating of coarse sand and again tamped. Ordinarily No. 4 chips are the proper size to use, although it is well to have different sizes at hand to fit the depth of depression to be filled. In making a paint patch, great care must be taken not to use an excess of either the bituminous material or the chips, as this will later on produce bumps. It is better to build up the depression gradually to the proper elevation by more than one application than to use an excess on the first treatment.

During the last few years the State has salvaged by the patching process which I have just described and by subsequent surface treatments, many miles of roads which had received an initial surface treatment and on which there had been no further maintenance. Some of these roads were in such a condition

when taken over that traffic could scarcely get over them, but today, after four years of maintenance they are carrying some of our heaviest traffic without showing any signs of wear or failure, and are becoming more and more like boulevards as time goes on.

BITUMINOUS MACADAM ROAD CONSTRUCTION

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In selecting the type of pavement to be laid in a certain section of road careful study should be given to the amount and kind of traffic going over this road at present and also to the probable increase within the next few years. Careful study should be made of the condition of sub-soil and the old base.

If the present road has a good gravel or stone base that is holding up very well, a bituminous macadam top course is a very economical pavement to use. If it is a new grade there is a question whether some other types of pavement would not be as economical. One of the greatest economic reasons for laying a bituminous macadam pavement is the salvaging of the old base. A well compacted gravel or stone surface that has been hammered by heavy traffic for a period of years has considerable value and that value may be conserved by laying a bituminous macadam top course.

Grading

Let us consider first the grading. By use of a grader, wheel scoops, drag scoops or wagons, the berms, shoulders and ditches should be brought to the proper cross section and in conformity to the base grade taking care of the drainage as necessary. Unlike many other types, the shoulders on a bituminous macadam road should be built prior to the laying of the pavement. Many bituminous macadam roads have been built with but little berm. Much better results could have been secured had there been a good berm built before the pavement.

The cross section for an 18 foot pavement includes a 2 inch crown in the pavement proper with berms 5 to 6 feet wide sloping ½ inch per foot and with a flat slope of approximately 4 to 1 into the ditch. The old base should be reinforced and levelled up with a water-bound macadam course or at least patched with water-bound patches so that the foundation grade will conform very closely to the finished crown and grade and to sufficient depth to hold up the loads which it will have to carry. Much care should be used in leveling up the old base